July 11, 2003

Docket Management Facility
US Department of Transportation (DOT)
Room PL-401
400 Seventh Street SW
Washington, DC 20590-000 1
Docket # USCG- 1998-4399-g

Docket#: USCG-2003-14757

MariTEL, Inc. ("MariTEL") hereby submits its comments to the United States Coast Guard ("USCG") in the above referenced proceeding designed to implement the Automatic Identification System ("AIS") carriage requirements of the Maritime Transportation Security Act of 2002 ("MTSA"). MariTEL is the largest holder of VHF Public Coast (VPC) station spectrum in the United States. In 1998, MariTEL actively participated in the FCC's auction #20 of VPC licenses and was the winning bidder for all nine (9) maritime VPC areas. As a result, MariTEL became the exclusive entity (except for site-specific incumbent licensees) authorized to operate 25 kHz duplex channels for VPC use. Among the channels for which MariTEL is licensed is channel 87, which is designated as "AIS1" by the International Telecommunications Union (ITU) and used for AIS communications on the high seas. In light of MariTEL's history and long-term commitment to providing maritime communication services, we appreciate the opportunity to comment on such an important development in maritime communications.[1]

MariTEL supports the goal of implementing an AIS in the United States ("US") and endorses the associated benefits:

> "it will facilitate vessel-to-vessel and vessel-to-shore communications; it will enhance good order and predictability on the waterways, promote safe navigation and contribute to maritime domain awareness to protect the security of our nation's ports and waterways."

MariTEL also supports the USCG's decision to harmonize its AIS system with the international ITU-R M.1371-1 AIS standard. This decision best supports effective VTS, ship-to-ship communication and domain awareness.

[1] MariTEL previously submitted comments in the USCG's 2002 – 14069 proceeding, which also addressed the implementation of AIS carriage requirements. MariTEL requests that its comments in that proceeding be incorporated herein by reference.

P.O. Box 533, Cumming, GA 30028-0533 • Telephone: 678-942-5622 • Fax: 678-942-5203
www.maritelusa.com

While MariTEL wholeheartedly supports the adoption and implementation of AIS in the US, we question the USCG's timing of such carriage requirements without the thought and planning necessary for an effective system. Additionally, because the USCG is proceeding with two timelines for AIS implementation – one timeline for VTS areas and another timeline outside VTS areas – the need to define a congruent frequency plan is heightened. The following information demonstrates that there are unresolved issues, which prevent the USCG from insuring a safe implementation of AIS in the US.

1. The USCG has not demonstrated that it can implement an AIS without the rights to channel 87

While this temporary interim rule does not overtly identify the channels that will be employed for AIS in the US (so called "AIS1" and "AIS2" channels), the USCG's reference to FCC Public Notice DA 02-1362[2] in this proceeding makes clear the USCG's intention to use the channels that have been internationally designated for the high seas - 87B and 88B –in the US territorial waters.

As the USCG is aware, MariTEL and the USCG entered into a Memorandum of Agreement ("MOA") pursuant to Section 80.371 of the FCC's rules that would have permitted USCG use of channel 87 for limited purposes. The USCG's planned use of AIS ITU-R M.1371-1 technology using a 25 kHz wide channel, however, uses more spectrum than MariTEL was required to provide by FCC regulation, which led to the termination of the MOA. In particular, with the exception of four (4) operational Vessel Traffic Service ("VTS") areas, at which the USCG is only allowed to use channel 87 until November 5, 2003, USCG use of channel 87 was terminated as of June 4, 2003. (See Attachment 1 for additional information.) MariTEL is committed to fulfilling its obligations under Section 80.371 of the FCC's rules to provide the USCG with spectrum to operate a ports and waterways safety system ("PAWSS") and is therefore waiting, as the FCC's rules contemplate, for the USCG to identify the narrowband-offset frequencies the USCG requires for that purpose. Since MariTEL terminated the MOA on May 3, 2003, however, it has yet to receive the USCG's proposal for the frequencies that will be required to meet PAWSS requirements. MariTEL has no regulatory or legal obligation to provide the USCG use of any particular channel -- 87 or otherwise -- for AIS. In fact, FCC regulations do not even require MariTEL to make available to the USCG the same channels in each VPC region.

While the USCG wishes to take the position that "matters pertaining to AIS licensing, equipment certification, and frequencies are subject to Federal Communications Commission regulations and are not addressed in this rule.." the USCG must not adopt carriage requirements that will be ineffective when they are implemented. Yet, these carriage requirements *will* be ineffective when adopted, because they will impermissibly

[2] *Wireless Telecommunications Bureau Announces Use of an Additional Frequency for the United States Coast Guard's Ports and Waterways Safety System*, DA 02-1362, June 13, 2002 (the "FCC Notice"). The USCG has also included this document in the electronic record of this proceeding as 2003-14757-6.

P.O. Box 533, Cumming, GA 30028-0533 • Telephone: 678-942-5622 • Fax: 678-942-5203
www.maritelusa.com

implicate spectrum over which a private entity, and not the USCG, has control. Contrary to the USCG's assertion, AIS channels are not subject to FCC regulations. The FCC has not designated frequencies for AIS use and has not initiated a proceeding to designate channels for AIS use. It is up to the USCG, not the FCC, to ensure that frequencies are available for AIS use. With respect to channel 87, the FCC Notice, cited by the USCG, simply recognizes rights, now terminated, that the USCG obtained through an agreement with MariTEL, not rights granted by the FCC. It is, therefore, ill-considered for the USCG to proceed, without addressing how it expects to operate an AIS system in the US without channels designated for that purpose.

The following are the implications for AIS stakeholders if the USCG proceeds without access to channel 87 for AIS in the US.

a. **Mariners** – Without the use of channel 87 for AIS in US territorial waters, vessels will be required to transition from channel 87 (AIS 1) to an alternate channel. ITU-R M.1371-1 AIS technology safely supports alternate AIS channel use in areas where AIS1 or AIS2 is not available. Further, International Association of Maritime Aids to Navigation and Lighthouse Authorities (IALA) provides several processes for safely transitioning vessels to alternate AIS channels including three (3) automatic and one (1) manual processes. Because none of these automatic methods are ubiquitously available in the US, the competent authority (the USCG) bears the responsibility to insure that mariners can manually transition to authorized AIS frequencies within US waters. If the mariner must manually tune to authorized AIS frequencies there must be clear direction from the competent authority (the USCG) for the mariners to safely manage AIS frequencies. If the mariner fails to safely transition to approved regional AIS channels, the vessel would become "invisible" to VTS and other ships, potentially causing the loss of property and/or life at sea.

b. **VTS / VMRS users** – If the USCG does not implement a method to automatically control tuning to authorized AIS channels, VTS vessels may become inadvertently tuned to the wrong channel for AIS and would not be able to communicate with the VTS operators or see other vessels.

c. **Marine Domain Awareness –** Use of alternate AIS channels complicates vessel tracking by requiring separate networks to track vessels inside and outside of the 12 mile US territorial waters, with the more challenging exception of the Gulf of Mexico whose territorial waters extend approximately from the southern tip of Texas to the southern tip of Florida. Additionally, relying on mariners to manually tune AIS transponders enhances the probability that a mariner will inadvertently become tuned to the wrong channel for AIS and become "invisible" to the AIS surveillance system. Extreme care is necessary to proactively monitor vessel movements across an AIS using multiple channels without impacting the effectiveness of the marine domain awareness capability.

P.O. Box 533, Cumming, GA 30028-0533 • Telephone: 678-942-5622 • Fax: 678-942-5203
www.maritelusa.com

2. <u>The USCG has not demonstrated how it will mitigate interference to the AIS from MariTEL's adjacent channel operation</u>

Galaxy Engineering, a wholly owned subsidiary of American Tower, Inc. (NYSE:AMT), has employed its wireless industry leading RF interference prediction software to evaluate the interference impact to the AIS from MariTEL's operation on adjacent channels. The USCG cites AIS testing of an early-generation DSC ITU-R M.825-3 as the basis to "identify any operational and technical problems that would have to be resolved before implementation of the latest AIS technology (ITU-R M.1371-1 version)." The USCG's obvious assumption is that an ITU-R M.825-3 duplex and an ITU-R M.1371-1 simplex system operate similarly. Galaxy's RF studies (see Attachment II) however, show that ITU-R M.1371-1 simplex systems are much more susceptible to RF interference from other users of maritime frequencies than the USCG anticipates. MariTEL's operation on adjacent frequencies (channels 27 and 28 for example) will unintentionally disrupt or shutdown ship-to-ship and/or ship-to-shore AIS communications. The USCG's decision to require carriage and reliance on AIS technology using channels in close proximity to MariTEL's commercial operations will potentially result in the loss of property and/or life at sea.

The following are the implications for several AIS stakeholders from interference from adjacent channel MariTEL commercial operations.

a. **<u>Mariners</u>** – RF interference to an AIS can disrupt or completely "over-load" an AIS transponder thereby significantly reducing or eliminating a vessel's ability to "see" other users of the AIS channel. Also, because of the intermittent nature of the interference and the potentially low number of vessel contacts in non-VTS areas, the mariner may not realize the AIS is functioning incorrectly. A vessel's reliance on an AIS in close proximity to MariTEL's commercial operations could lead to unnecessary loss of property and/or life at sea.

b. **<u>VTS / VMRS users</u>** – RF interference affects a VTS using an AIS in a similar manner to the impact to mariners. AIS shore sites can be disrupted or completely "over-loaded," thereby significantly reducing or eliminating a VTS's ability to "see" other users of the AIS channel. A VTS's reliance on an AIS in close proximity to MariTEL's commercial operations could lead to unnecessary loss of property and/or life at sea.

c. **<u>Marine Domain awareness</u>** – An AIS deployed outside of a VTS/VMRS area for domain awareness will be impacted similarly to VTS AIS operations. AIS shore sites can be disrupted or completely "over-loaded", thereby significantly reducing or eliminating the ability to "see" other users of the AIS channel for domain awareness.

P.O. Box 533, Cumming, GA 30028-0533 • Telephone: 678-942-5622 • Fax: 678-942-5203
www.maritelusa.com

3. The USCG has not demonstrated that it can eliminate interference from ship station AIS transponders on MariTEL's adjacent commercial channels

It is well accepted within IALA and the International Marine Organization (IMO) that an ITU-R M.1371-1 AIS simplex mobile will interfere with adjacent maritime channel operations. IMO's SN/Cir.227 dated 6 January 2003 recommends stringent ship borne antenna separation guidelines to minimize, but not eliminate, this interference (see Attachment III - Sections 2.1-2.3). Galaxy Engineering's interference study confirms IMO's findings and predicts that commercial communication on channels around a mobile AIS unit's channel, will severely impact, if not completely eliminate, the viability of those channels for commercial operations.

The interference to MariTEL's adjacent channels from the currently adopted AIS carriage requirement is an unconstitutional taking of MariTEL's property without just compensation. As the U.S. Supreme Court has made clear, a government regulation that prohibits the beneficial use[3] of private property violates the Fifth Amendment absent the payment of just compensation.[4] Under the court's reasoning in *Loretto,* the AIS carriage requirement amounts to a taking of Channel 87 and adjacent spectrum. The carriage requirement voids MariTEL's investment-backed expectations for the commercial use of roughly 33% of MariTEL's licensed spectrum – including at a minimum channels 27, 87[5], and 28 - by permanently physically occupying this spectrum with Coast Guard's caused or mandated harmful interference.[6] Such a taking of MariTEL's property can be made only upon payment of just compensation to MariTEL.[7]

---

[3] *See Lucas v. South Carolina Coastal Council*, 505 U.S. 1003, 1019 (1992) ("there are good reasons for our frequently expressed belief that when [a property owner] has been called upon to sacrifice all economically beneficial uses in the name of the common good, that is, to leave his property economically idle, he has suffered a taking.").

[4] *See, e.g., Loretto v. Teleprompter Manhattan CATV Corp. et al.,* 458 U.S. 419, 426-27 (1982) (holding that, while even extensive regulation of private property is allowable in the public interest, governmental action that prohibits beneficial use of property is a taking, and requires just compensation) (citing *Penn Central Transoprtation Co. v. New York City,* 438 U.S. 104, 127-128 (1978)).

[5] *Id.* at 426.

[6] *Id.* at 426-27. Electromagnetic radio spectrum is as much a finite, tangible, physical property as land—its quantity is clearly defined, and separate physical portions are allocated and assigned by the Federal Communications Commission in order to eliminate interference problems that decrease the value of spectrum overall. The interference resulting from the AIS carriage requirment would render channel 87 unusable as much as a local ordinance prohibiting the use of beachfront property. *See Lucas*, 505 U.S. at 1003.

[7] *Id.* at 441.

P.O. Box 533, Cumming, GA 30028-0533 • Telephone: 678-942-5622 • Fax: 678-942-5203
www.maritelusa.com

The following are the implications for several AIS stakeholders from AIS vessel interference to other MariTEL channels.

a. **Mariners** – Limits the ability of mariners that are required to carry AIS transponders to receive maritime data communication services such as e-mail, short messaging and location services from a maritime VHF network.

b. **MariTEL**– Galaxy Engineering RF studies indicates that MariTEL will lose approximately 33% of its licensed frequency, which severely impacts MariTEL's ability to serve the marine industry as a communications service provider.

Realizing that there is no agreement allowing the USCG to use MariTEL's channel 87 and adjacent spectrum for AIS in the US; that the use of a ITU-R M.1371-1 simplex AIS operation causes significant implications to both the AIS and MariTEL's operations and that the AIS carriage requirement is effective immediately -- which allows no time for resolution of these issues, MariTEL urges the USCG to suspend its carriage requirements until such time as these issues are resolved. An unreliable and ineffective AIS is clearly not the goal of this regulatory action. However, until such time as arrangements are made to resolve these questions, MariTEL believes it is impossible to deploy a safe and reliable AIS in the US.

Sincerely,

Signature Not Verified
Dan Smith
Digitally signed by Dan Smith
DN: cn=Dan Smith, o=MariTEL, c=US
Date: 2003.07.11 15:41:17 -05'00'

Dan Smith
President/CEO

P.O. Box 533, Cumming, GA 30028-0533 • Telephone: 678-942-5622 • Fax: 678-942-5203
www.maritelusa.com

May 27, 2003

Captain Richard Hartman, Jr.
United States Coast Guard
Chief, Office of Communications System
2100 2nd Street, S. W.
Washington, DC 20593-0001
Staff Symbol: G-SC-2

Dear Captain Hartman,

We are in receipt of your letter of May 16, 2003 advising of your understanding of MariTEL's termination of the Memorandum Of Agreement (MOA), which is effective June 4, 2003.

Your letter states that the United States Coast Guard (USCG) reads section IX(E) of the MOA to "allow the Coast Guard to continue using Channels 87A/B for six months after termination." We terminated the provisions of the MOA under section VIII (B), which is not governed by Section IX. Nevertheless, while we believe we are not obligated to do so, we agree to the USCG's request of a six-month period to transition off of channel 87 A/B in the PAWSS locations where, it is our understanding, that AIS systems are fully operational today: Sault Ste. Marie, Lower Mississippi, Prince William Sound and Berwick Bay. No other station authorized by the USCG or the National Telecommunications and Information Administration ("NTIA") should use channel 87 A/B after June 4, 2003.

In light of these developments, we request the USCG facilitate the removal of MariTEL's channel 87 A/B from the NTIA's frequency database. Additionally, we request that USCG notify all current and prospective users that channel 87 A/B is not available without an agreement with MariTEL. Specifically, we request the USCG notify the St. Lawrence Seaway (SLSDC) of these developments and direct the SLSDC to contact MariTEL to begin separate, independent discussions regarding the future use of channel 87 A/B.

Additionally, we expect that the USCG will not proceed with plans to use spectrum that has not been agreed upon until a new agreement has been reached. Actions by the USCG, such as the issuance of a mandatory carriage requirement that will necessarily result in the use of channel 87 for Automatic Identification System ("AIS") purposes could result in irreparable damage to the long-term use of our spectrum. We have stated our position concerning the mandatory carriage requirements resulting from the Maritime Transportation Security Act (MTSA) in our public comments that recommend the carriage requirements not be issued until the frequencies that will be utilized are secured on a long-term basis thus preventing substantial interference on MariTEL's spectrum. We realize that the anticipated carriage requirements do not contain reference to particular channels. However, because the USCG is well aware that AIS equipment, by default, uses channel 87, its imposition of a carriage requirement will have a direct impact on the availability of that channel to MariTEL.

Because channel 87 A/B is not available for use as channel AIS 1 in U.S. territorial waters, we request that the USCG, as the competent authority for the United States, notify the international maritime governing bodies, the International Association of Lighthouse Authorities and International Maritime Organization (IALA, IMO) of the unavailability of channel 87 A/B so that appropriate actions can be taken to not cause interference to MariTEL's channel 87 A/B in our licensed areas.

You request that MariTEL identify the frequencies that it proposes the USCG use instead of channel 87. As you know, Section 80.371 of the rules of the Federal Communications Commission contemplate that the USCG will *submit to each VPC licensee a plan specifying up to two narrowband channel pairs offset 12.5 kHz for use in the PAWSS.* Because we believe that our current efforts are essentially a re-initiation of the process contemplated by Section 80.371 of the FCC's rules, it seems appropriate for the USCG to propose up to two (2) narrowband offset channels for our consideration.

The focus of the MOA discussions we have had to date has been on the bandwidth desired by the USCG. We have other areas of concern that the MOA did not clearly specify and want to insure that we reach consensus on the following:

1. A clear definition of the geographic boundary requirements of the PAWSS.
2. The method to expand the PAWSS beyond the current congressional framework.
3. Use of MariTEL spectrum for applications other than ports and waterways traffic management.
4. Definition of interference boundaries for the spectrum supplied by MariTEL for use in the PAWSS.
5. A secure, long-term mechanism in lieu of a MOA.

We continue to be available on a weekly basis to work to reach a new agreement that will satisfy both parties interest.

Best regards,

Dan Smith
President/CEO

Copy:

FCC WTB
Russell Fox

P.O. Box 533, Cumming, GA 30028-0533 • Telephone: 678-942-5622 • Fax: 678-942-5203
www.maritelusa.com

Galaxy Engineering Services
13000 Deerfield Pkwy, Ste 107
Alpharetta, Ga 30004
Phone 770.751.8330
Fax 770.751.8327

Shared Site Interference Analysis - Considerations for AIS 1371 and Adjacent Channel Operations

June16,2003

Table of Contents

Limited Warranty

Galaxy Engineering Services warrants that this analysis was performed substantially using the methods that are referenced and described in this report using the information on the antenna site that was provided to Galaxy Engineering Services. Galaxy Engineering Services disclaims all other warranties, either express or implied, including, but not limited to, implied warranties of merchantability and fitness for a particular purpose. This limited warranty gives you specific legal rights. You may have others, which vary from state to state.

Galaxy Engineering Services' entire liability and your exclusive remedy shall be return of the price paid to Galaxy Engineering Services for the analysis.

In no event will Galaxy Engineering Services be liable to you for damages, including any loss of profits, lost savings, or other incidental or consequential damages arising out of your use or inability to use the analysis. Because some states do not allow the exclusion or limitation of liability for consequential or incidental damages, the above limitation may not apply to you.

1.0 Analysis Summary

The results of this analysis indicate the distinct probability of interference problems from adjacent channels to the AIS system from Part 80 radios operating in the vicinity of the AIS transponders. Reciprocally, the part 80 radios will suffer from interference from the AIS system on the ship borne unit. The level of interference indicates the need for AIS and Part 80 systems to be jointly planned for appropriate horizontal or vertical separation to minimize interference to both systems. Interference from adjacent channels will severely hamper the ability of the AIS system to "listen" to boats in the open seas and could very well destroy operations all together. Joint planning and implementation is recommended in order to deal with these issues.

2.0 Transmitter Noise Analysis

Transmitter noise is interference caused by noise generated by a transmitter that falls within a receiver's bandwidth. This noise level is compared with the receiver's susceptibility. Receiver susceptibility is determined by calculating the equivalent noise floor of the receiver system. This is based on the sensitivity of the receiver and the modulation scheme. For this analysis, susceptibility is considered to be 6 dB below the noise floor. The analysis predicts the transmitter power level in the receiver bandwidth at the receive frequency. The difference between the receiver susceptibility and the predicted interfering power level is called the noise margin. If the noise margin is positive, the number represents the margin before interference occurs. If the noise margin is negative, the amount represents the level of improvement in isolation required between the transmitter and receiver. The system also accumulates the effects of all transmitters on a receiver at a site.

The levels in figure 1.0-1 show the predicted worst-case transmitter noise margin between receivers and transmitters at the site.

TX System	TX (MHz)	RX System	RX (MHz)	N_{TX} (dBm)	$L_{TX\text{-}Ant}$ (dB)	$L_{Ant\text{-}Ant}$ (dB)	$N_{at\ Ant}$ (dBm)	$S_{at\ Ant}$ (dBm)	N_{Margin} (dB)
Part 80 AUX 25k	161.9625	AIS 1371	161.975	47.9	2.6	22.0	23.3	-132.6	-155.9
AIS 1371	161.975	Part 80 AUX 25k	161.9625	58.0	2.6	22.0	33.4	-132.6	-166.0
Part 80 AUX 25k	161.95	AIS 1371	161.975	15.8	4.5	22.0	-10.7	-132.6	-121.9
AIS 1371	161.975	Part 80 AUX 25k	161.95	58.0	4.5	22.0	31.5	-132.6	-164.1
Part 80 AUX 25k	161.9375	AIS 1371	161.975	6.9	6.3	22.0	-21.5	-132.6	-111.1
AIS 1371	161.975	Part 80 AUX 25k	161.9375	54.3	6.3	22.0	25.9	-132.6	-158.5
Part 80 AUX 25k	161.925	AIS 1371	161.975	-2.1	8.2	22.0	-32.3	-132.6	-100.2
AIS 1371	161.975	Part 80 AUX 25k	161.925	26.0	8.2	22.0	-4.2	-132.6	-128.4

Table 1.1 – Part 80 Aux Radio on 25 kHz Channel vs AIS 1371 Radio Transmitter Noise

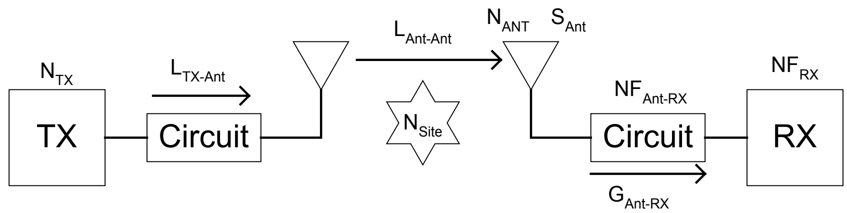
TX System	TX (MHz)	RX System	RX (MHz)	N_{TX} (dBm)	$L_{TX\text{-}Ant}$ (dB)	$L_{Ant\text{-}Ant}$ (dB)	$N_{at\ Ant}$ (dBm)	$S_{at\ Ant}$ (dBm)	N_{Margin} (dB)
Part 80 AUX 12.5k	161.9625	AIS 1371	161.975	7.0	2.6	22.0	-17.6	-132.6	-114.9
AIS 1371	161.975	Part 80 AUX 12.5k	161.9625	55.5	2.6	22.0	30.9	-132.1	-163.0
Part 80 AUX 12.5k	161.95	AIS 1371	161.975	-3.4	4.5	22.0	-29.8	-132.6	-102.7
AIS 1371	161.975	Part 80 AUX 12.5k	161.95	55.5	4.5	22.0	29.0	-132.1	-161.1
Part 80 AUX 12.5k	161.9375	AIS 1371	161.975	-13.3	6.3	22.0	-41.7	-132.6	-90.9
AIS 1371	161.975	Part 80 AUX 12.5k	161.9375	51.8	6.3	22.0	23.4	-132.1	-155.5
Part 80 AUX 12.5k	161.925	AIS 1371	161.975	-23.2	8.2	22.0	-53.5	-132.6	-79.1
AIS 1371	161.975	Part 80 AUX 12.5k	161.925	23.6	8.2	22.0	-6.7	-132.1	-125.4

Table 1.2 – Part 80 Aux Radio on 12.5 kHz Channel vs AIS 1371 Radio Transmitter Noise

Figure 1.0-1 Transmitter Noise Summary

2.1 Worst Case Example Transmitter Noise Example Calculation

The worst case example of transmitter noise is from the transmitter (161.9625 MHz) in the transmit circuit in system ‘part 80 AUX’ to the receiver (161.975 MHz) in system ‘AIS1’. The transmitter noise margin value of -114.9 dB is calculated using the following method:



Step 1: Calculate transmitter noise at receiver’s antenna.

F_{TX} = 161.9625 MHz	Transmit frequency
F_{RX} = 161.975 MHz	Receive frequency
BW_{RX} = 20 kHz	Receiver bandwidth
P_{TX} = 44.0 dBm	Transmitter power
PSD_{TX} = -80.0 dBc	Relative power emitted by trans. in receiver band (from transmitter’s power spectral density curve)
$L_{TX\text{-}Ant}$ = 2.6 dB	Loss from transmitter to transmitter’s antenna at F_{RX}
$L_{Ant\text{-}Ant}$ = 22.0 dB	Antenna (or coupler) isolation at F_{RX}

N_{TXC} — Noise emitted by transmitter in receiver’s band relative to carrier

$= PSD_{TX} + 10 \times \log(BW_{RX})$
$= -80.0 + 10 \times \log(20000.0)$
$= -37.0$ dBc

N_{TX} — Noise at transmitter in receiver’s band

$= P_{TX} + (N_{TXC})$
$= 44.0 + (-37.0)$
$= 7.0$ dBm

N_{Ant} — Transmitter noise at receiver’s antenna

$= N_{TX} - (L_{TX\text{-}Ant} + L_{Ant\text{-}Ant})$
$= 7.0 - (2.6 + 22.0)$
$= -17.6$ dBm

Step 2: **Calculate the susceptibility of the receiver at its antenna.**

$Sense_{RX}$ = -117.0 dBm	Receiver sensitivity
[C/N] = 18.0 dB	Equivalent carrier-to-noise level for specified receiver sensitivity
$NF_{Ant\text{-}RX}$ = 0.5 dB	Equivalent noise figure of sector from antenna (or coupler) to receive input
N_{Site} = 3.6 dBkTB	Site noise from Site Noise curve relative to kTB
$G_{Ant\text{-}RX}$ = -0.5 dB	Gain from antenna (or coupler) to receiver

kTB =
= $-174.0 + 10 \times \log(BW_{RX})$
= $-174.0 + 10 \times \log(20000.0)$
= -131.0 dBm

Thermal noise in the receiver bandwidth at room temperature.

NF_{RX}
= $Sense_{RX}$ - [C/N] - (kTB)
= -117.0 - 18.0 - (-131.0)
= -4.0 dB

Noise figure of receiver

NF'_{Ant}
= $10^{(NF_{Ant\text{-}RX})/10} + [(10^{(NF_{RX}/10)}-1)/ 10^{(G_{Ant\text{-}RX}/10)}]$
= $10^{(0.5)/10} + [(10^{(-4.0/10)}-1)/ 10^{(-0.5/10)}]$
= 0.4

Noise factor at antenna

NF_{Ant}
= $10 \times \log(NF'_{Ant})$
= $10 \times \log(0.4)$
= -3.5 dB

Noise factor at antenna in decibels

NF_{SysAnt}
= $10\times\log(10^{(NF_{Ant} / 10)} + 10^{(N_{Site} / 10)})$
= $10\times\log(10^{(-3.5/10)} + 10^{(3.6/10)})$
= 4.4 dB

System noise figure at antenna adds external noise at the site to the internal noise at the antenna.

$S_{RX\ Ant}$
= kTB + NF_{SysAnt} - 6
= -131.0 + 4.4 - 6
= -132.6 dBm

Susceptibility of receiver to interference at receive antenna

Step 3: Calculate the noise margin.

N_{Margin}
= $S_{RX\ Ant}$ - N_{Ant}
= -132.6- (-17.6)
= -114.9 dB

Margin between noise reaching receive antenna and level of susceptibility at antenna

3.0 Receiver Desensitization Analysis

Receiver desensitization is interference caused by transmitter signals coupling into a receiver and desensitizing the receiver. The leakage power is compared with the receiver's desensitization level. For this analysis, receiver desensitization level is defined as level that degrades the receiver sensitivity by 1 dB. A positive desensitization margin represents the margin before interference occurs. If the desensitization margin is negative, the amount represents the level of improvement in isolation required between the transmitter and receiver at the transmitter frequency. The system also accumulates the effects of all transmitters on a receiver at a site.

The levels in figure 2.0-1 show the predicted worst-case receiver desensitization margin between the receivers and transmitters at the site.

TX System	TX (MHz)	RX System	RX (MHz)	P_{TX} (dBm)	$L_{TX\text{-}Ant}$ (dB)	$L_{Ant\text{-}Ant}$ (dB)	$L_{Ant\text{-}RX}$ (dB)	$P_{at\ RX}$ (dBm)	$D_{at\ RX}$ (dBm)	D_{Margin} (dB)
Part 80 AUX 25k	161.9625	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	-70.0	-90.7
AIS 1371	161.975	Part 80 AUX 25k	161.9625	40.0	0.7	22.0	0.5	16.7	-50.0	-66.7
Part 80 AUX 25k	161.95	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	-20.0	-40.7
AIS 1371	161.975	Part 80 AUX 25k	161.95	40.0	0.7	22.0	0.5	16.7	-5.0	-21.7
Part 80 AUX 25k	161.9375	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	25.0	4.3
AIS 1371	161.975	Part 80 AUX 25k	161.9375	40.0	0.7	22.0	0.5	16.7	25.0	8.3
Part 80 AUX 25k	161.925	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	30.0	9.3
AIS 1371	161.975	Part 80 AUX 25k	161.925	40.0	0.7	22.0	0.5	16.7	30.0	13.3

Table 3.1 – Part 80 Aux Radio on 25 kHz Channel vs AIS 1371 Radio Receiver Desensitization

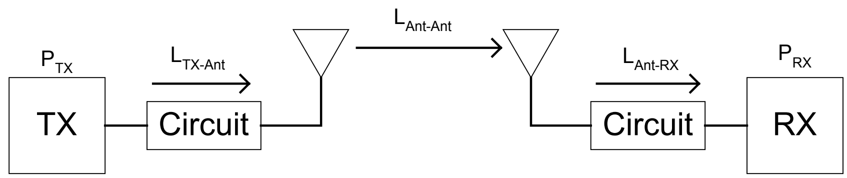
TX System	TX (MHz)	RX System	RX (MHz)	P_{TX} (dBm)	$L_{TX\text{-}Ant}$ (dB)	$L_{Ant\text{-}Ant}$ (dB)	$L_{Ant\text{-}RX}$ (dB)	$P_{at\ RX}$ (dBm)	$D_{at\ RX}$ (dBm)	D_{Margin} (dB)
Part 80 AUX 12.5k	161.9625	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	-70.0	-90.7
AIS 1371	161.975	Part 80 AUX 12.5k	161.9625	40.0	0.7	22.0	0.5	16.7	5.0	-11.7
Part 80 AUX 12.5k	161.95	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	-20.0	-40.7
AIS 1371	161.975	Part 80 AUX 12.5k	161.95	40.0	0.7	22.0	0.5	16.7	30.0	13.3
Part 80 AUX 12.5k	161.9375	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	25.0	4.3
AIS 1371	161.975	Part 80 AUX 12.5k	161.9375	40.0	0.7	22.0	0.5	16.7	30.0	13.3
Part 80 AUX 12.5k	161.925	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	30.0	9.3
AIS 1371	161.975	Part 80 AUX 12.5k	161.925	40.0	0.7	22.0	0.5	16.7	30.0	13.3

Table 3.2 – Part 80 Aux Radio on 25 kHz Channel vs AIS 1371 Radio Receiver Desensitization

Figure 2.0-1 Receiver Desensitization Summary

3.1 Worst Case Example Receiver Desensitization Example Calculation

The worst case example of receiver desensitization is from the transmitter (161.9625 MHz) on transmit circuit in system ‘Part 80 AUX’ to the receiver (161.975 MHz) in system ‘AIS 1371’. The calculated margin of **Error! Reference source not found.** dB is predicted by using the following method:



Step 1: Calculate transmitter power at receiver.

F_{TX} = 161.9625 MHz	Transmit frequency
F_{RX} = 161.975 MHz	Receive frequency
BW_{RX} = 20 kHz	Receiver IF bandwidth (for 25 kHZ channel)
P_{TX} = 44.0 dBm	Transmitter power
L_{TX-Ant} = 0.7 dB	Loss from transmitter to transmitter's antenna at F_{TX}
$L_{Ant-Ant}$ = 22.0 dB	Antenna (or coupler) isolation at F_{TX}
L_{Ant-RX} = 0.5 dB	Losses from receiver's antenna to receiver at F_{TX}
P_{RX} = P_{TX} - (L_{TX-Ant} + $L_{Ant-Ant}$ + L_{Ant-RX}) = 44.0 - (0.7 + 22.0 + 0.5) = 20.7 dBm	Power emitted by transmitter in transmitter's band reaching receiver

Step 2: Calculate desensitization margin at receiver.

$Densense_{RX}$ = -70.0 dBm	Desensitization level of receiver at F_{TX}. This value is derived from the LNA's power rejection mask curve.
$D_{RX\ Margin}$ = $Densense_{RX}$ - (P_{RX}) = -70.0 - (20.7) = -90.7 dB	Margin between desensitization level of the receiver and the transmitter power reaching the receiver

INTERNATIONAL MARITIME ORGANIZATION
4 ALBERT EMBANKMENT
LONDON SE1 7SR

Telephone: 020 7735 7611
Fax: 020 7587 3210
Telex: 23588 IMOLDN G

IMO

E

Ref. T2/8.02

SN/Circ.227
6 January 2003

GUIDELINES FOR THE INSTALLATION OF A SHIPBORNE AUTOMATIC IDENTIFICATION SYSTEM (AIS)

1 The Sub-Committee on Safety of Navigation (NAV), at its forty-eighth session (8 to 12 July 2002), agreed on guidelines for the installation of a Shipborne Automatic Identification System (AIS) and also agreed that they should be issued for use on a voluntary basis. The Guidelines describe the shipborne AIS installation matters and are meant to be used by manufacturers, installers and surveyors to ensure good installation practices.

2 The Maritime Safety Committee, at its seventy-sixth session (2 to 13 December 2002), concurred with the Sub-Committee's views, approved the Guidelines as set out at annex and encouraged their use for AIS installation purposes on a voluntary basis.

3 Member Governments are invited to bring the annexed guidelines to the attention of all concerned.

***

ANNEX

GUIDELINES FOR THE INSTALLATION OF A SHIPBORNE AUTOMATIC IDENTIFICATION SYSTEM (AIS)

1 General

The Automatic Identification System (AIS) Class A is defined by IMO and has been made a carriage requirement by the latest revision of SOLAS chapter V. AIS provides information that may be used for the navigation of the ship. It is therefore essential that the information provided by AIS be reliable.

The AIS itself has been standardised by the International Telecommunications Union (ITU) and the International Electrotechnical Commission (IEC) and is subject to type approval. In order to fulfil the reliability requirements of information exchange, care should be taken to ensure that the AIS is correctly installed.

This document contains guidelines for manufacturers, installers, yards, suppliers and ship surveyors. It does not replace documentation supplied by the manufacturer.

The guidelines take into account the following conventions, regulations, instructions and guidelines:

- IMO resolution MSC.90(73) Annex 7, Adoption of amendments to the International Convention for the Safety of Life at Sea, 1974, as amended.
- IMO resolution MSC.74(69) Annex 3, Recommendation on performance standards for AIS.
- ITU Radio Regulations (RR).
- IEC 60092 (series), Electrical Installations on Ships.
- IEC 60533 Electrical and Electronic Installations in Ships – Electromagnetic Compatibility.

1.1 Survey

Surveys on Convention ships should be carried out in accordance with the rules laid down in resolution A.746(18) "Survey Guidelines under the harmonised system of survey and certification", and "Protocol of 1988 relating to the International Convention for the Safety of Life at Sea, 1974, as amended."

1.2 Documentation

For the AIS installation the following drawings shall be submitted:

- Antenna layout
- AIS arrangement drawing
- Block diagram (interconnection diagram)

An initial installation configuration report should be produced during installation and kept on board.

2 AIS Installation

2.1 Interference to the Ship's VHF Radiotelephone

The AIS shipborne equipment, like any other shipborne transceiver operating in the VHF maritime band, may cause interference to a ship's VHF radiotelephone. Because AIS is a digital system, this interference may occur as a periodic (e.g. every 20 s) soft clicking sound on a ship's radiotelephone. This affect may become more noticeable when the VHF radiotelephone antenna is located near the AIS VHF antenna and when the radiotelephone is operating on channels near the AIS operating channels (e.g. channels 27, 28 and 86).

Attention should be paid to the location and installation of different antennas in order to obtain the best possible efficiency. Special attention should be paid to the installation of mandatory antennas like the AIS antennas.

2.2 VHF Antenna Installation

2.2.1 Location

Location of the mandatory AIS VHF antenna should be carefully considered. Digital communication is more sensitive than analogue/voice communication to interference created by reflections in obstructions like masts and booms. It may be necessary to relocate the VHF radiotelephone antenna to minimize interference effects.

To minimise interference effects, the following guidelines apply:

- The AIS VHF antenna should have omnidirectional vertical polarisation.

- The AIS VHF antenna should be placed in an elevated position that is as free as possible with a minimum of 2 metres in horizontal direction from constructions made of conductive materials. The antenna should not be installed close to any large vertical obstruction. The objective for the AIS VHF antenna is to see the horizon freely through 360°.

- The AIS VHF antenna should be installed safely away from interfering high-power energy sources like radar and other transmitting radio antennas, preferably at least 3 m away from and out of the transmitting beam.

- Ideally there should not be more than one antenna on the same level. The AIS VHF antenna should be mounted directly above or below the ship's primary VHF radiotelephone antenna, with no horizontal separation and with a minimum of 2 m vertical separation. If it is located on the same level as other antennas, the distance apart should be at least 10 m.

2.2.2 Cabling

The cable should be kept as short as possible to minimise attenuation of the signal. Double screened coaxial cables equal or better than RG214 are recommended.

All outdoor installed connectors on the coaxial cables should be waterproof by design to protect against water penetration into the antenna cable.

Coaxial cables should be installed in separate signal cable channels/tubes and at least 10 cm away from power supply cables. Crossing of cables should be done at right angles (90°). Coaxial cables should not be exposed to sharp bends, which may lead to change the characteristic impedance of the cable. The minimum bend radius should be 5 times the cable's outside diameter.

2.2.3 Grounding

Coaxial down-leads should be used for all antennas, and the coaxial screen should be connected to ground at one end.

2.3 GNSS Antenna installation

Class A AIS should be connected to a GNSS antenna.

2.3.1 Location

The GNSS antenna should be installed where it has a clear view of the sky. The objective is to see the horizon freely through 360° with a vertical observation of 5 to 90° above the horizon. Small diameter obstructions, such as masts and booms, do not seriously degrade signal reception, but such objects should not eclipse more than a few degrees of any given bearing.

Locate the antenna at least three meters away from and out of the transmitting beam of high-power transmitters (S-Band Radar and/or Inmarsat systems). This includes the ship's own AIS VHF antenna if it is designed and installed separately.

If a DGNSS system is included or connected to the AIS system, the installation of the antenna should be in accordance with IEC 61108-4, Ed 1, annex D.

2.3.2 Cabling

To achieve optimum performance, the gain of the antenna pre-amplifier should match the cable attenuation. The resulting installation gain (pre-amplifier gain - cable attenuation) should be within 0 to 10 dB.

The coaxial cable between the antenna and the AIS shipborne station connector should be routed directly in order to reduce electromagnetic interference effects. The cable should not be installed close to high-power lines, such as radar or radio-transmitter lines or the AIS VHF antenna cable. A separation of one meter or more is recommended to avoid degradation due to RF-coupling. Crossing of antenna cables should be done at 90° to minimise magnetic field coupling.

All outdoor installed connectors on the coaxial cables should be waterproof by design to protect against water penetration into the antenna cable.

2.4 Power source

The AIS should be connected to an emergency power source.

2.5 Synchronization

After installation, the AIS should be synchronised properly on UTC and that position information, if provided, should be correct and valid.

3 Bridge Arrangement

3.1 Minimum Keyboard and Display

The functionality of the Minimum Keyboard and Display (MKD) should be available to the mariner at the position from which the ship is normally operated. This can be by means of the AIS' internal MKD (integrated or remote) or through the equivalent functionality on a separate display system

3.2 Pilot plug

A pilot input/output port is part of an AIS Class A station. A plug connected to this port should be installed on the bridge near the pilot's operating position so that a pilot can connect a Personal Pilot Unit (PPU).

The pilot plug should be configured as follows:

- AMP/Receptacle (Square Flanged (-1) or Free-Hanging (-2)), Shell size 11, 9-pin, Std. Sex 206486-1/2 or equivalent with the following terminations:

    - TX A is connected to Pin 1
    - TX B is connected to Pin 4
    - RX A is connected to Pin 5
    - RX B is connected to Pin 6
    - Shield is connected to Pin 9

3.3 Display system

If there is navigational equipment capable of processing and displaying AIS information such as ECDIS, radar or an integrated system available on board the ship, the AIS Class A mobile system may be connected to that system via the AIS Presentation Interface (PI). The PI (input/output) should meet the requirements of IEC 61162-2.

The display system can also include the functionality of an MKD, see 3.1.

3.4 Installation of the BIIT (Built-in Integrity Test) function

The AIS requires that an alarm output (relay) be connected to an audible alarm device or the ships alarm system, if available.

Alternatively, the BIIT alarm system may use the alarm messages output on the PI, provided its alarm system is AIS compatible.

4 Dynamic data input

4.1 External Sensors

The AIS has interfaces (configurable as IEC 61162-1 or 61162-2) for position, heading and rate of turn (ROT) sensors. In general, sensors installed in compliance with other carriage requirements of SOLAS Chapter V should be connected to the AIS.[1] The sensor information transmitted by AIS should be the same information being used for navigation of the ship. The interfaces should be configured as given in annex 3. Interfacing problems might occur if the existing sensors found on board do not have serial (IEC 61162) outputs.

4.2 Position, COG and SOG

GNSS sensors normally have IEC 61162 outputs for position, COG and SOG suitable for directly interfacing the AIS. However, it is important to note that:

- The Geodetic Datum of the position data transmitted by the sensor is WGS 84 and that an IEC 61162 DTM sentence is configured.

- AIS is able to process two reference points for its antenna position, one for external and one for an internal sensor. If more than one external reference point is used, the appropriate information needs to be input to the AIS to adjust reference point information.

4.3 Heading

A compass providing heading information is a mandatory sensor input to the AIS. A converter unit (e.g. stepper to NMEA) will be needed to connect AIS if the ship's compass does not provide an IEC 61162 output. Some ships of less than 500 gross tonnage may not carry a compass providing heading information.

4.4 Rate of Turn

All ships may not carry a Rate-Of-Turn (ROT) Indicator according to resolution A.526(13). However, if a rate-of-turn indicator is available and it includes an IEC 61162 interface, it should be connected to the AIS.

If ROT information is not available from a ROT indicator, the direction of turn may (optionally) be derived from heading information through:

- The compass itself,
- An external converter unit (see paragraph 4.3),
- The AIS itself (see annex 1).

---

[1] Installation of the AIS does NOT establish a need to install additional sensors above carriage requirements.

4.5 Navigational Status

A simple means should be provided for the operator to input the ship's navigational status (e.g. underway using engine, at anchor, not under command, restricted in ability to maneuver, etc) information into the AIS. The AIS may be connected to the ship's navigational status lights.

5 Static Information

The AIS standards require that certain static, voyage-related, and dynamic information be entered manually, normally by means of the MKD, or by means of IEC 61162 sentences "SSD" and "VSD" via the presentation interface if such provisions exist.

5.1 Entered at initial installation of AIS

Information that should be entered at the initial installation of the AIS includes:

- Maritime Mobile Service Identity (MMSI) number
- IMO vessel number
- Radio call sign
- Name of ship
- Type of ship
- Dimension/reference for position of the electronic position fixing device (EPFD) antenna (see paragraph 5.2)

Access to **MMSI, IMO number** and other AIS controls (like power and channel settings) will be controlled, e.g. by password.

The **Call Sign**, **Name of Ship** and **Type of Ship** should be input to the AIS, either manually using the MKD or by means of IEC 61162 sentences "SSD" and "VSD" via the PI. Type of Ship information should be in accordance with the table given in annex 2 (Table 18 from Rec. ITU-R M.1371-1).

For example, a cargo ship not carrying dangerous goods, harmful substances, or marine pollutants; would use identifier "70". Pleasure craft would use identifier "37". Note that those ships whose type identifier begins with a "3" should use the fourth column of the table.

Depending on the vessel, cargo and/or the navigational conditions, this information may be voyage related and would therefore need to be changed before beginning or at some time during the voyage. This is defined by the "second digit" in the fourth column of the table.

5.2 Reference point of position

The AIS stores one "external reference point" for the external GNSS antenna position and one "internal reference point" if an internal GNSS is to be used as fallback for position reporting. The locations of theses reference points have to be set during installation using values A, B, C, D; as described in paragraph 5.3.

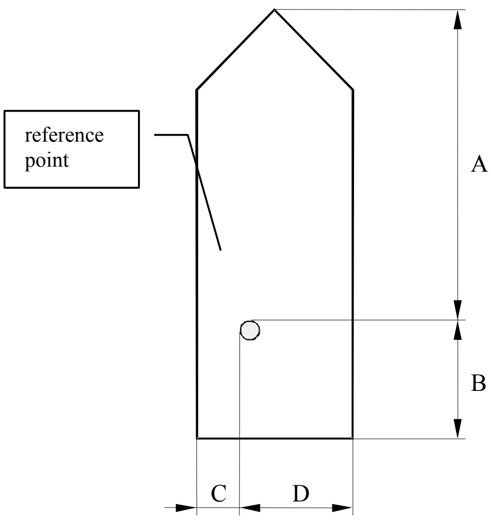
The external reference point may also be a calculated common reference position.

Additionally, the content of the Ship Static Data ("SSD") sentence on the PI, including the "reference point for position" is being processed by the AIS, and the AIS' memory for the "external reference point" is set in accordance with the content of this "SSD" (e.g. used by an INS).

5.3 Ship's dimensions

Ship's dimensions should be entered using the overall length and width of the ship indicated by the values A, B, C, and D in the following figure.

Ship's dimensions (A+B and C+D) should be identical when entering internal and external reference points.



	Distance (m)
A	*0 – 511 ; 511 =511 m or greater*
B	*0 – 511 ; 511 = 511 m or greater*
C	*0 - 63 ; 63 = 63 m or greater*
D	*0 - 63 ; 63 = 63 m or greater*

<u>The dimension A should be in the direction of the transmitted heading information (bow)</u>
Reference point of reported position not available, but dimensions of ship are available: $A = C = 0$ *and* $B \neq 0$ *and* $D \neq 0$.
Neither reference point of reported position nor dimensions of ship available: $A = B = C = D = 0$ *(=default)*
For use in the message table, A = most significant field, D = least significant field

In the rare case of an EPFD antenna installed in the portside corner of a rectangular bow, the values A and C would be zero. Should this be the case, one of these values should be set to 1 in order to avoid misinterpretation as "not available" because A=C=0 is used for that purpose.

6 Long-range function

The AIS' long-range function needs a compatible long-range communication system (e.g. Inmarsat-C or MF/HF radio as part of the GMDSS).

If this is available, a connection between that communication system and the Class A mobile unit can be made. This connection is needed to activate the LR function of AIS. Its input/output port should meet the requirement of IEC 61162-2.

Annex 1

RATE OF TURN

The AIS provides the Rate of Turn (ROT) information to other ships in order to early detect ships manoeuvres. There are two possible parameters indicating turning of a ship derived from two different sensors (see Figure 3: ROT sensor input):

- the heading from a GYRO or THD and
- the rotation rate itself from a Rate of Turn-indicator.

If a Rate of Turn Indicator according to resolution A.526(13) is connected, the AIS should use this information to broadcast both direction and value of turn on the VDL.

If valid ROT or HDG data is available from other external sources (Gyro, INS,...), the AIS should use this information to broadcast the direction of turn on the VDL, if greater than 5^{o} in 30 s (might also be implemented as 2.5° in 15 s by configuration); the AIS may also derive ROT information from HDG internally for that purpose.

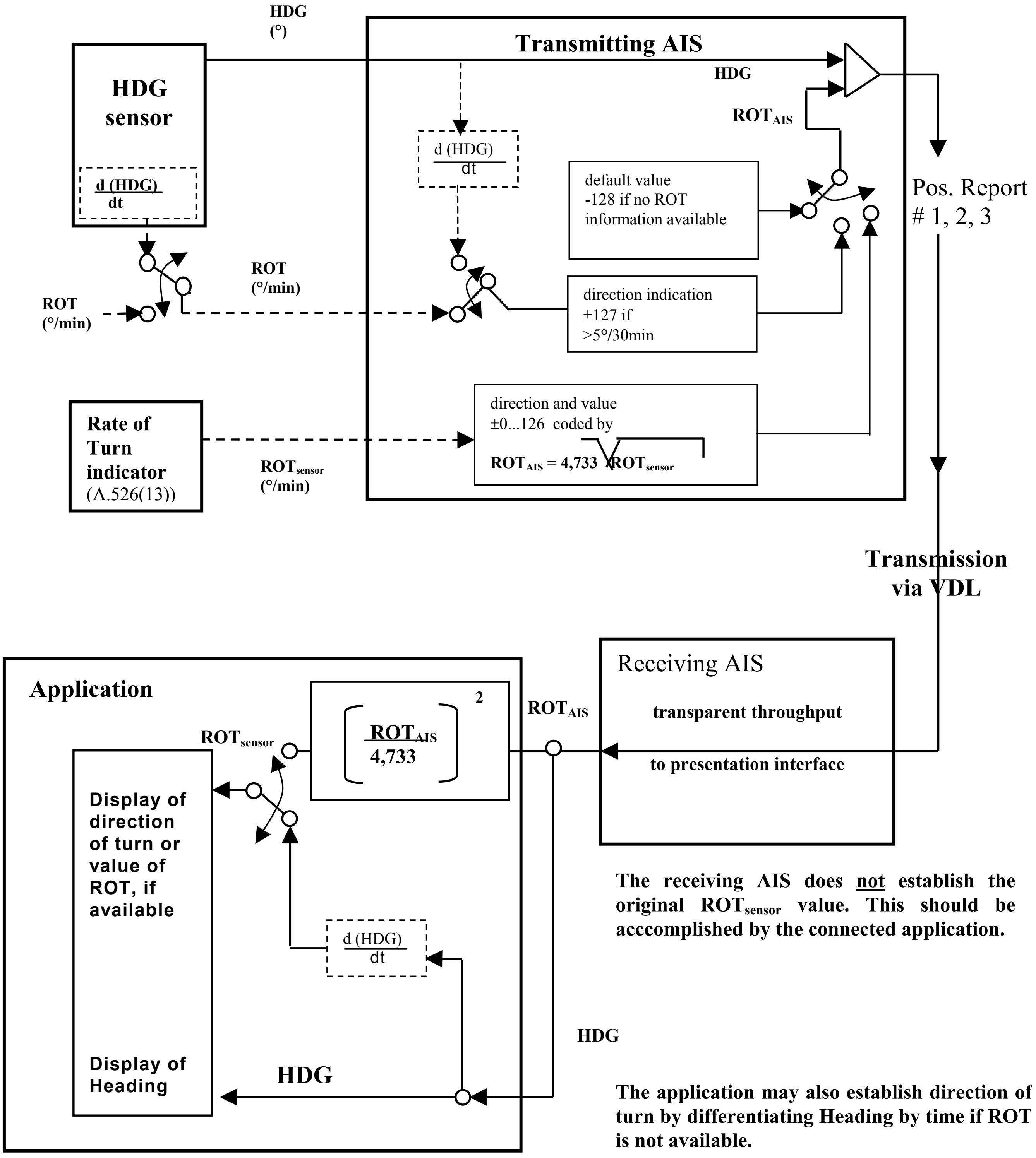
If no ROT information is available, the AIS should transmit default values indicating "not available". ROT data should not be derived from COG information.
If a ship is not required to carry Turn-Indicator or if external sensor fails, the AIS should react according to following priorities:

ROT sensor fallback conditions

Priority	**Affected data in msg 1, 2, 3 ⇒** / **Position Sensor status**	**contents of ROT field**
1.	Rate of Turn Indicator in use [1]	0..+ 126 = turning right at up to 708° per minute or higher; 0..- 126 = turning left at up to 708° per minute or higher Values between 0 and 708°/min should be coded by ROT_{AIS}=4.733 SQRT(ROT_{sensor}) degrees/min where ROT_{sensor} is the Rate of Turn as input by the external Rate of Turn Indicator (TI). Values of 709° per minute and above should be limited to 708° per min.
2.	other ROT source in use [2]	+ 127 = turning right at more than 5^{o}/30s (No TI available) 0 no turn - 127 = turning Left at more than 5^{o}/30s (No TI available)
3.	no valid ROT information available	–128 (80 hex) indicates no turn information available (default)

[1] Rate of Turn Indicator according to resolution A.526(13); determined by talker ID
[2] i.e. based on HDG information

Rate of Turn sensor input overview



Annex 2

TYPE OF SHIP TABLE

Identifiers to be used by ships to report their type			
Identifier No.	Special craft		
50	Pilot vessel		
51	Search and rescue vessels		
52	Tugs		
53	Port tenders		
54	Vessels with anti-pollution facilities or equipment		
55	Law enforcement vessels		
56	Spare – for assignments to local vessels		
57	Spare – for assignments to local vessels		
58	Medical transports (as defined in the 1949 Geneva Convention and Additional Protocols)		
59	Ships according to Resolution No 18 (Mob-83)		
Other ships			
First digit (*)	Second digit (*)	First digit (*)	Second digit (*)
1 - reserved for future use	0 – All ships of this type	-	0 – Fishing
2 – WIG	1 – Carrying DG, HS, or MP IMO hazard or pollutant category A	-	1 – Towing
3 - see right column	2 – Carrying DG, HS, or MP IMO hazard or pollutant category B	3 – Vessel	2 – Towing and length of the tow exceeds 200 m or breadth exceeds 25 m
4 – HSC	3 – Carrying DG, HS, or MP IMO hazard or pollutant category C	-	3 – Engaged in dredging or underwater operations
5 – see above	4 – Carrying DG, HS, or MP IMO hazard or pollutant category D	-	4 – Engaged in diving operations
	5 – reserved for future use	-	5 – Engaged in military operations
6 – Passenger ships	6 – reserved for future use	-	6 – Sailing
7 – Cargo ships	7 –reserved for future use	-	7 – Pleasure Craft
8 – Tanker(s)	8 – reserved for future use	-	8 – reserved for future use
9 – Other types of ship	9 – No additional information	-	9 – reserved for future use

DG: Dangerous Goods.
HS: Harmful Substances.
MP: Marine Pollutants.

(*) **NOTE** – The identifier should be constructed by selecting the appropriate first and second digits.

Annex 3

RECOMMENDED IEC 61162 SENTENCES

To connect external sensors it is recommended to configure the following sentences as indicated below.

Preferred IEC 61162-1 Sensor Sentences

Data	IEC 61162-1 Sentence formatters	
	preferred	optional
Reference datum	DTM	
Positioning system: Time of position Latitude / Longitude Position accuracy	GNS GLL	GGA , RMC
Speed Over Ground (SOG)	VBW	VTG, OSD, RMC
Course Over Ground (COG)	RMC	VTG, OSD
Heading	HDT	OSD
RAIM indicator	GBS	
Rate Of Turn (ROT)	ROT	